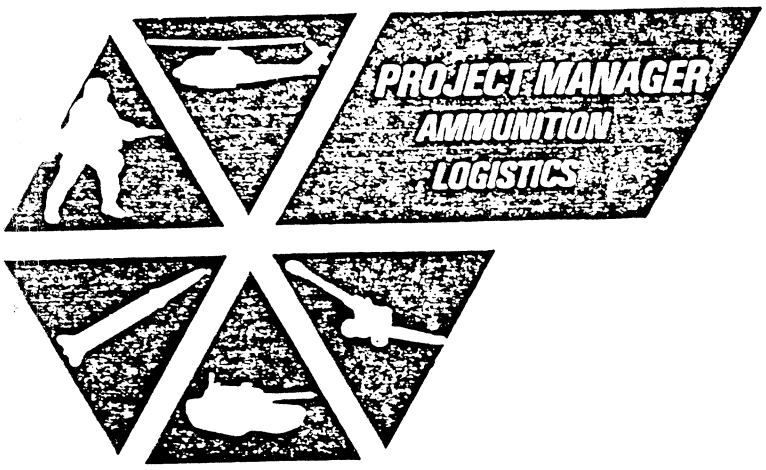

QUICKLOAD PROGRAM
TECHNICAL DATA PACKAGE

4.2 Inch Mortar Ammunition Rack and and Fire Suppression System

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1. EXECUTIVE SUMMARY

A. Description:
The 4.2 inch mortar rack is built up using wooden modules and steel plates. Twenty four modules, each containing one box of two M329A2 Composition B loaded mortar rounds are placed in a conex. Plastic bottles containing an all-weather fire extinguishing liquid are placed in the empty spaces of the modules to provide fire protection in case of a detonation of one box of 4.2 inch mortar rounds.

B. Use:
The rack effectively prevents mass detonation of the Composition B loaded rounds. The presence of fire extinguishing agent prevents burning of the wooden racks and storage modules subsequent to the detonation.. Thus, in addition to preventing mass detonation, there are no subsequent cook-offs of rounds to endanger personnel.

C. Benefits:
The rack limits the maximum credible event to two rounds, reduces the inhabited building distance (IBD) from 1250 ft to 310 ft within a 30 degree arc in front of the doors of the conex and 100 ft everywhere else, and prevents late time cook-offs of warheads. The associated encumbered land is reduced from 113 acres to 1 acre.

D. Building Information:
Construction of the wooden modules requires personnel skilled at the journeyman carpenter level. Assembly of the rack in the conex can be accomplished by troop labor.

E. Lifetime:
If treated lumber is used the modules should last 25 years. Untreated will rot unless it is kept dry.

F. Drawbacks:
The rack has been designed for M329A2 mortar rounds in their original wooden shipping boxes. The rack is not suitable for storing other explosive containing rounds. Although other types of rounds such as illuminating and white phosphorous may be stored opposite the rack in the conex, doing so nullifies the reduced IBD and requires the standard 1250' IBD be used.

2. BACKGROUND

A. An inspection tour of the U.S. bases in the Republic of Korea by the Department of Defense Explosives Safety Board (DDESB) members revealed that, in many cases, ammunition is stored close to occupied areas. Limited available space precludes simply moving ammunition away from sensitive points. The inspection found that conex containers were used to store 4.2 inch M329A2 mortar rounds. Mass detonation of the mortar rounds would be expected, given the storage conditions involved, since the rounds are assigned to the 1.1 hazard class. The danger radius around a conex, due to hazards from fragments in case of detonation, was 1250 ft, as assigned by the DDESB. A method of reducing the danger radius was needed.

3. ITEM DESCRIPTION

A. The 4.2 inch ammunition rack is designed to contain boxes of M329A2 mortar rounds DODICS 1315-C697 and 1315-C699. Other 4.2" mortar rounds are not authorized. The rack is constructed of three components. The basic item is a stacking module and one is required for every box of ammunition to be stored. The second component is a 1/4 inch thick steel plate which must be placed between each layer of ammunition. The third component is the fire suppression system. Three 4700 ml containers and four 2000 ml containers are required for each stacking module. Figures 1 and 2 show construction details of the stacking modules. Figure 3 shows a module which has been constructed. Figure 4 shows a module with a box of 4.2 inch mortar ammunition upon it in its reversed orientation. NOTE: The lumber used should be to the dimensions in the drawings. Any deviation could result in the mortars or the fire suppression containers not fitting. The stacking module is designed so that the wooden shield can be placed to the right or left of the box of ammunition.

B. To assemble the rack, a row of stacking modules is made by placing them side by side so they are in contact with each other as shown in figure 5. Four 2000 ml plastic containers filled chock full with the three part mixture are placed below the wooden shield laying down, and three full 4700 ml plastic containers are placed on top of the wooden shield laying down, for every module. A 27 inch wide 1/4 inch thick steel plate 94 inches long is then placed on top of modules. The length is

long enough to essentially cover the row of modules while allowing a small amount of maneuvering space while constructing the rack.

C. A second row of modules with the fire suppressive containers is then placed on top of the steel plate, but in reversed orientation so that the wooden shields are over the locations where the boxes of ammunition were placed in the modules in the first row. Another steel plate is added and a third row of modules can be added with an orientation opposite of the second row so it repeats the first rows orientation. Additional rows can be added by placing a 1/4 inch thick steel plate between each row of modules and reversing the orientation of each row. The fire suppression containers must be added for each module. A six row rack which can hold twenty four 4.2 inch mortar boxes (48 rounds) is shown in figures 6 and 7. Figure 8 shows that rack loaded with ammunition.

D. In order to keep the fragments within the corresponding distances noted (in the event of an accidental detonation of an HE mortar) the conex container must be adequately sandbagged and a barrier must be placed in front of the doors. There must be a minimum of three layers of sandbags against the three walls and two layers on the roof. To minimize the kickouts and fragment distances in front of the doors the barrier must be located approximately 12 feet in front of the doors. The barrier is shown in figure 9 and the sandbagging can be seen in figure 10. As an alternate to the figure 9 door barrier, a sandbag door barrier minimum 4 ft thick, 24 ft long by 8 ft high may be used.

4. USE OF THE ITEM

A. The rack may be used to store 4.2 inch M329A2 (C697 or C699) mortar ammunition provided the rack is configured as described, the ammunition is stored in the original shipping boxes and properly placed in the racks, the conex is properly sandbagged, and the proper barrier is placed in front of the conex doors.

B. If other types of mortars i.e. illuminating and white phosphorous, must also be stored in the conex, it is recommended that they be stored on the opposite wall of the conex, as far from the HE ammunition rack as the situation

permits. Storage of these rounds nullifies the IBD reduction and requires the standard 1250 ft IBD be used. However, use of the rack in this circumstance is strongly recommended and contributes significantly to explosives safety.

5. BENEFITS

A. The rack provides protection against mass detonation of the M329A2 mortar rounds and protection against any subsequent fire, given the detonation of one box of 2 rounds. The inhabited building distance is reduced from 1250 ft normally required to 310 ft within a 30 degree arc in front of the conex doors and 100 ft everywhere else. A diagram which depicts the reduced IBD is shown in figure 10. The associated encumbered land requirement is reduced from 113 acres to only 1 acre as demonstrated in figure 11.

B. If other types of rounds such as illuminating and white phosphorous must also be stored in the conex then there is no IBD reduction. Use of the rack in this circumstance still however provides an increase in overall safety.

6. LIFE EXPECTANCY

A. If treated lumber is used to construct the modules, the life expectancy should be at least 25 years. If normal lumber is used, lifetime will be dependent on keeping the wood dry. The wood of the ammunition boxes is treated to prevent decay.

7. SITE PLANS SUBMISSION

A site plan must be submitted in accordance with AR 385-60 and AR 385-64 to the Department of Defense Explosives Safety Board and approval must be obtained prior to the start of construction.

8. CONSTRUCTION

A. Construction of the wooden modules requires personnel skilled at the journeyman carpenter level. Assembly of the rack in the conex can be accomplished by troop labor.

B. The first step in building the module would be to cut to the proper length all material necessary to build the quantity desired. A fixture should be used to properly and accurately lay out and nail the 1 x2's to the 1 x 3's. This would be an accurate and efficient method of fabrication. The second process would be a fixture to align and nail the 2 x 4 material to the 2 x 12 and a second for aligning and nailing the 2 x 6's to the 2 x 12. The initial set up time needed to build the fixtures would greatly reduce the time needed to build the modules and reduce the possibility of modules that would be rejected because dimensions or fabrication error would not allow use of the fire suppressant containers.

C. The fire suppression system is a passive system consisting of two main parts, a fire suppressive liquid and plastic containers to hold the liquid. There are two sizes of containers used in the system, a 4700 ml (1.25 gallon) container and a 2000 ml container. These containers will be stored on their sides so they all must be leak proof. The fire suppressive liquid used consists of three parts, water, propylene glycol, and a foam concentrate, aqueous film forming foam (AFFF). For the 4700 ml container there are 1200 ml of water , 2300 ml of propylene glycol and approximately 1200 ml of AFFF. For the 2000 ml containers there are 500 ml of water, 1000 ml of propylene glycol and approximately 500 ml of AFFF. The propylene glycol is an anti freeze agent. Water may be substituted for the propylene glycol if it is certain that the temperature will never fall below the freezing point of water. When mixing the liquid solution for either container the water and propylene glycol solutions are mixed first and then the remainder of the volume is filled with AFFF. NOTE: The AFFF must be added slowly so that little or no foaming occurs. This will allow filling the containers virtually chock full with little or no air space in the containers. If excessive air is left in a container, the container may not rupture when detonation occurs. It is obvious that the fire extinguishing liquid must be released from the container to be effective.

9. BILL OF MATERIALS

			Cost for 24	Treated
2x12x27"	(1 ea)	@ $2	48.00	67.20
2x4x11.5"	(3 ea)	@ .24/ft	17.28	24.19
2x6x11.5"	(2 ea)	@ .40/ft	19.20	26.88
1x3x24"	(3 ea)	@ .11 ft/ft	7.92	11.09
1x2x27"	(2 ea)	@ .09/ft	4.32	6.05
Nails			6.00	6.00
			102.72	141.00

NOTE: The above estimate is based on government stocked materials, price as of 17 June 91, geographical area - Aberdeen Proving Ground, Md.

Steel Plates (5 ea) 24x96x1/4" @ 78	390
Two Liter Bottles (96 ea) @ 6.25	600
4.7 Liter Jugs (72 ea) @ 6.25	450
Propylene Glycol (265 liters) @ 1.50/liter	400
AFFF (133 liters) @ 1.50/liter	200
Total	2040

The total cost of materials for 24 modules using treated wood is $2181.00

10. PROCUREMENT/REQUISITION INFORMATION

A. Materials for the modules can be obtained locally.

B. The aqueous film forming foam (AFFF) can be obtained by NSN# 4210-01-056-8343.

C. The propylene glycol may be purchased from:
DOW Chemical Co. (or equivalent)
4700 South Sycrause Pkwy.
Suite 900
Denver, CO 80237
303-740-9300

D. As an alternative to propylene glycol, common antifreeze (ethylene gycol) may be substituted however this must be approved by the local environmental office.

E. The 2 liter bottles may be purchased from:
Cole Palmer (or equivalent)
PN: N-06019-62
7425 North Oak Park Ave
Chicago, IL 60648-9730
1-800-323-4340

F. The 4.7 liter bottles may be purchased from:
Atlantic Plastic Containers (or equivalent*)
PN: 51
P.O. Box 313
Pleasentville, NJ 08232
609-646-8010

* empty 1 gallon ethylene glycol antifreeze plastic jugs may be submitted.

11. CONSTRUCTION COST AND TIME

A. It is estimated that utilizing a skilled journeyman level carpenter, to cut material and assemble 24 modules would take approximately 12 labor hours, assuming adequate and proper power tools are available. The estimated cost would be $540 for labor.

12. ACKNOWLEDGEMENTS

This work was sponsored by the Project Manager for Ammunition Logistics and preliminary tests were performed at Socorro, New Mexico by the TERA Group of the New Mexico Institute of mining and Technology. The final proof testing was performed at the Utah Test and Training Range by the Ogden Air Logistic Center of Hill Air Force Base. The final rack design was engineered by Mr. John D. Waugh of the US Army Human Engineering Laboratory's Tactical Logistic System Team. The shop drawing was prepared by Mr. Whit Sheldon of the US Army Human Engineering Laboratory.

13. ADDITIONAL INFORMATION

Any questions or comments related to this Technical Data Package or the Quickload Program should be directed to:

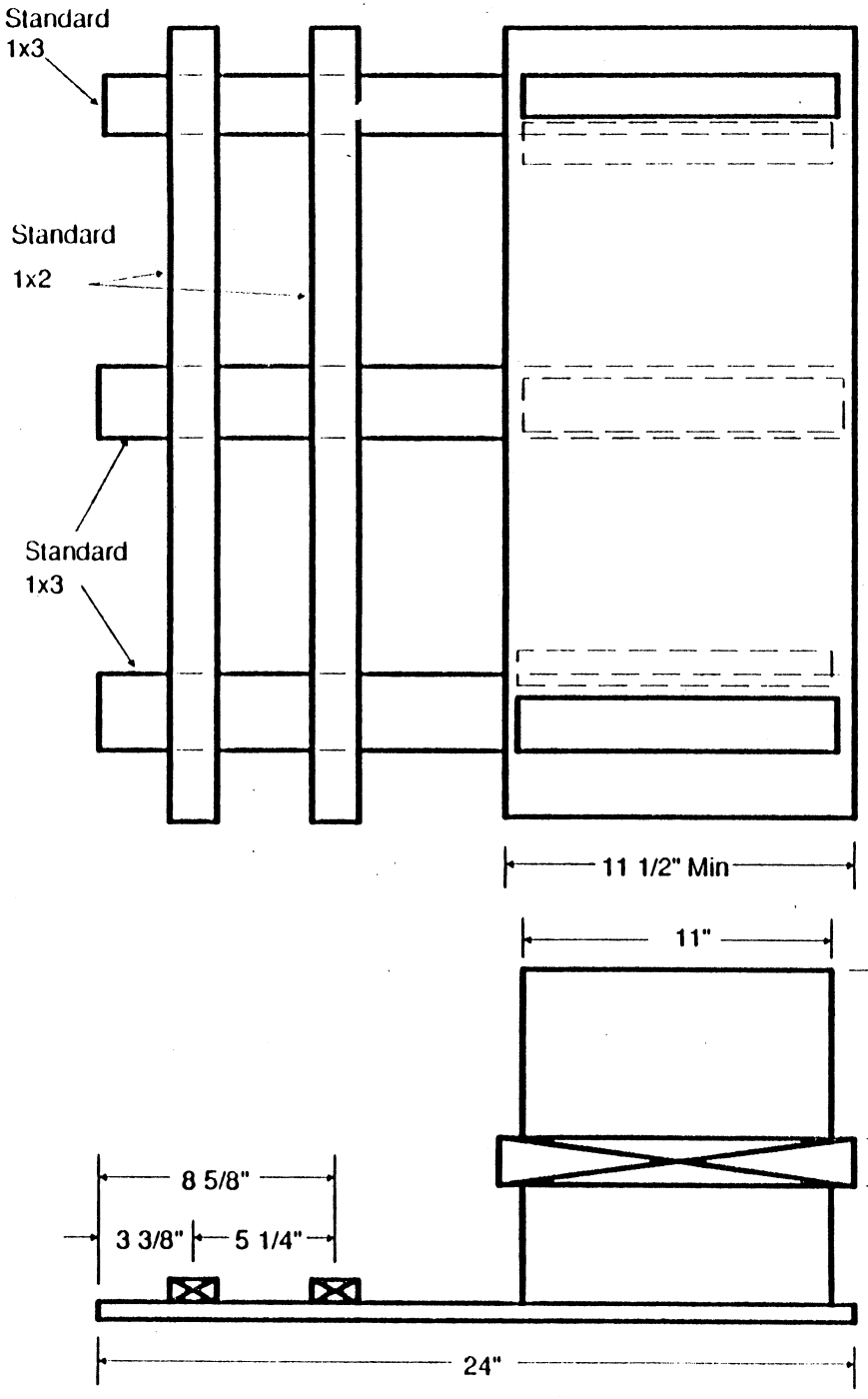
Project Manager, Ammunition Logistics
ATTN: AMCPM-AL, Robert Rossi
Picatinny Arsenal, NJ 07806-5000
DSN 880-2188 or (201) 724-2188

Details of 4.2 inch Mortar Stacking Module

Indicates End Grain

All dimensions marked Minimum (Min) must be at least that dimension in order for the fire suppressent containers to fit properly. An oversized tolerance of + 1/4" is allowed

To nail 2x4's to 2x12's use 16D common nails
For all else use 4D common nails



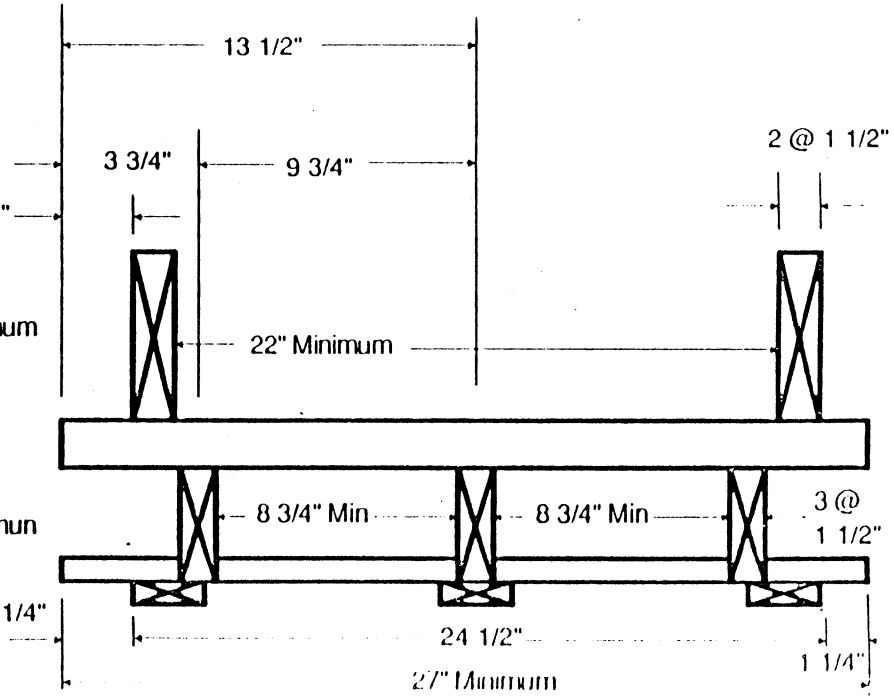


Figure 1

4.2 inch Mortar Stacking Module

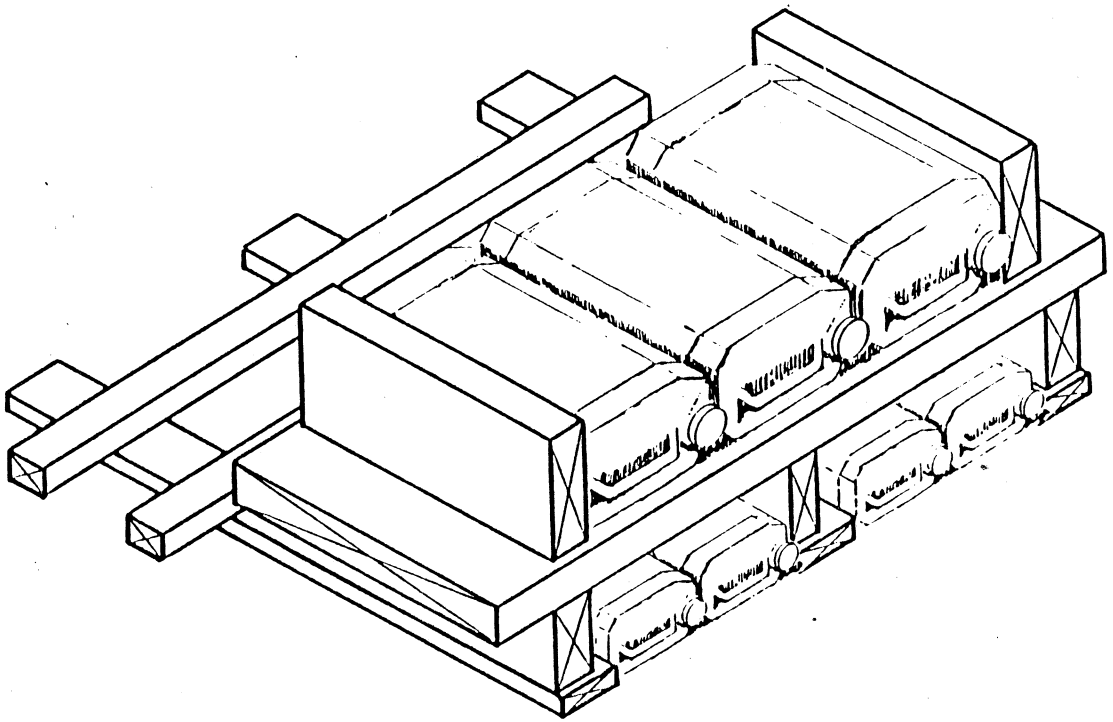


Figure 2

Photo of Constructed Module

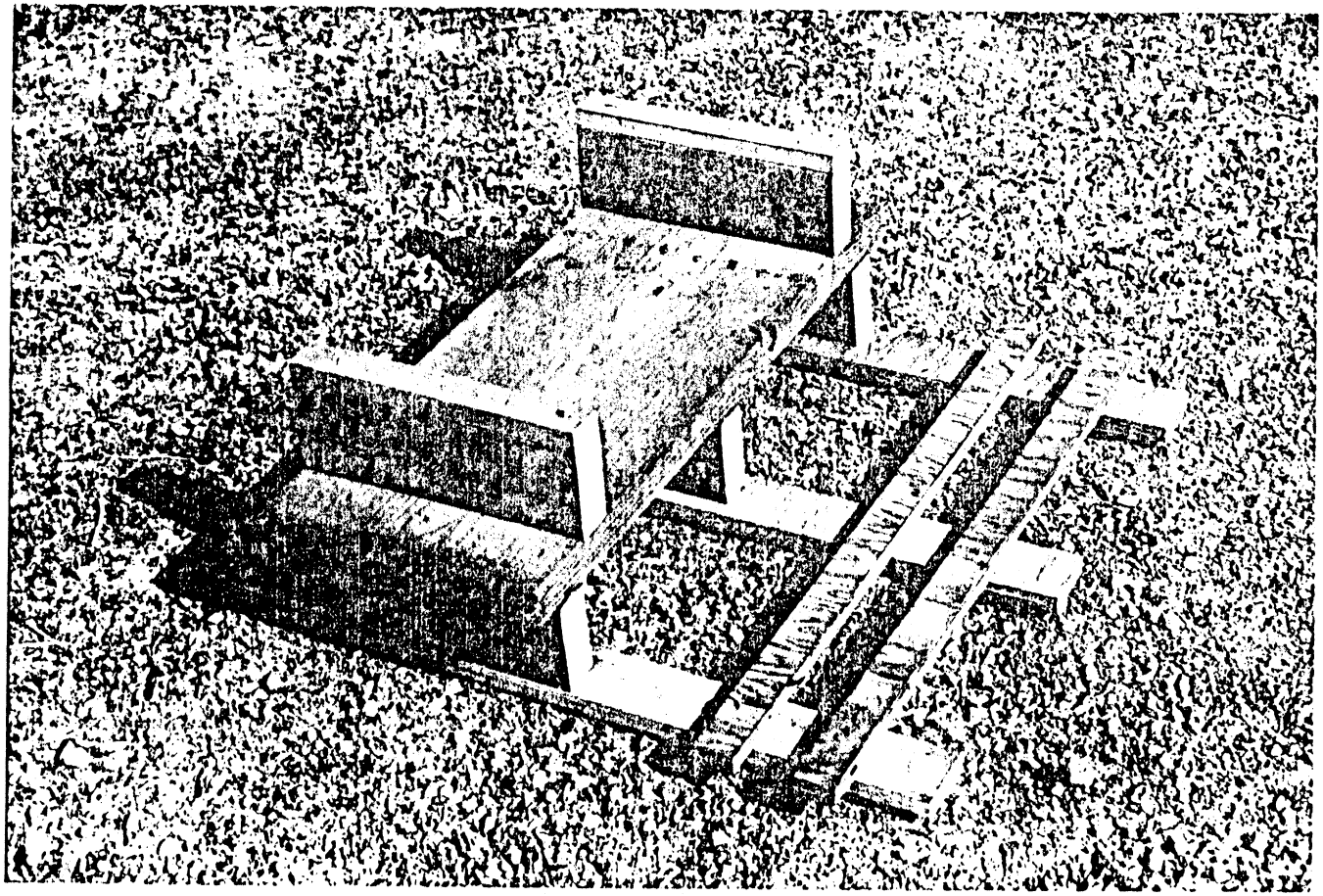


Figure 3

Photo of Module with a Box of Ammo

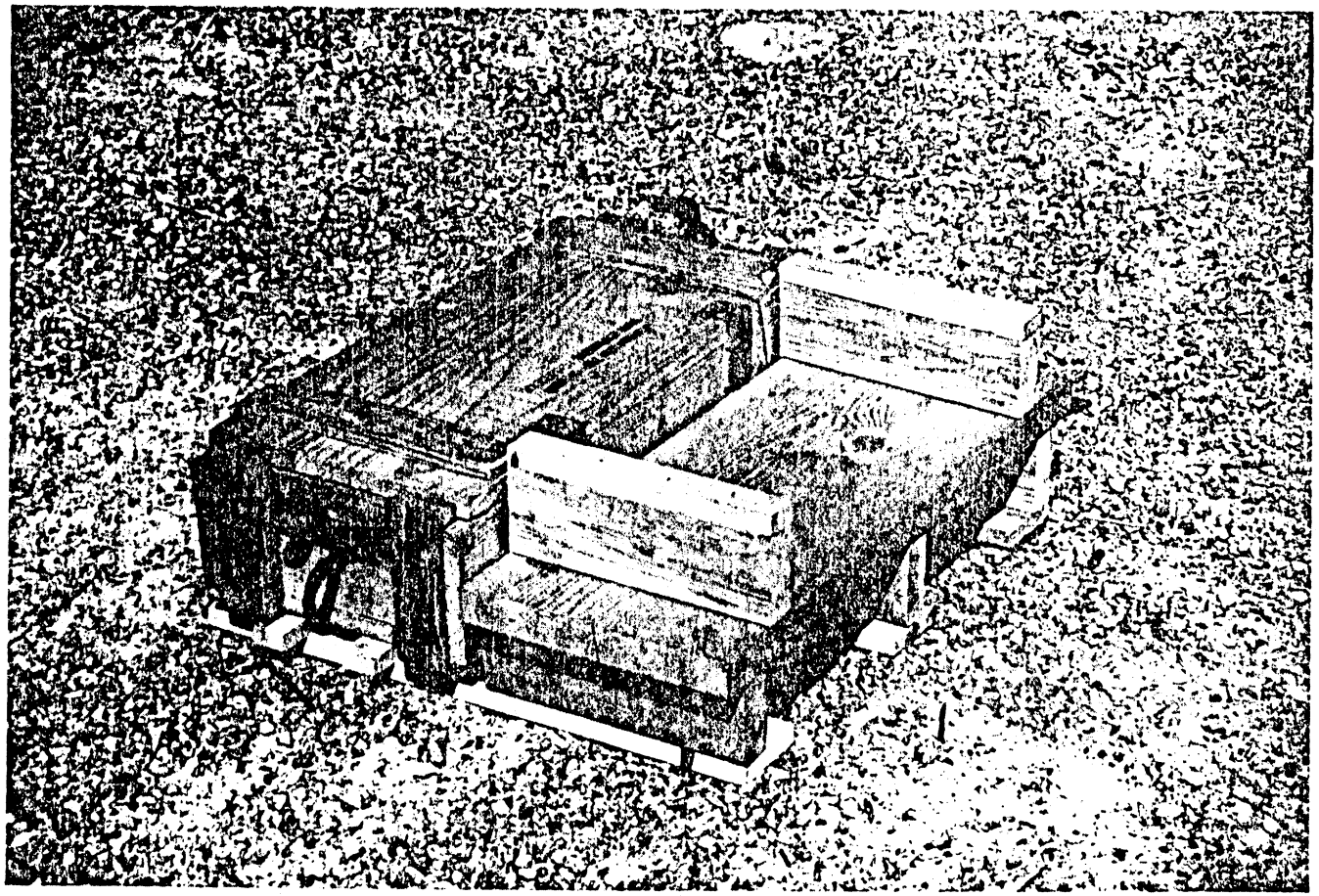


Figure 4

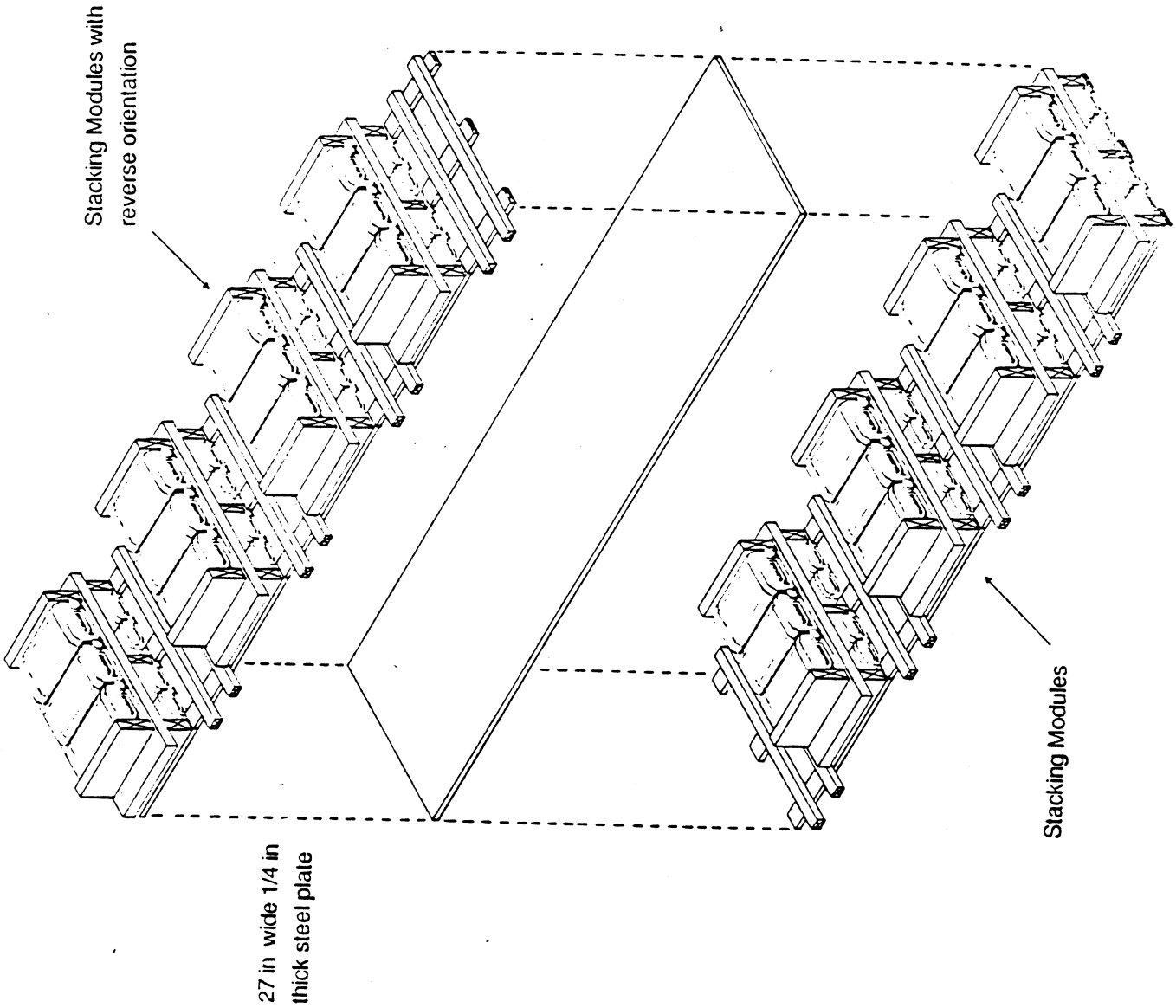
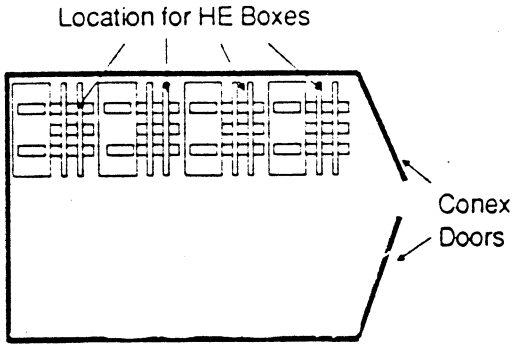
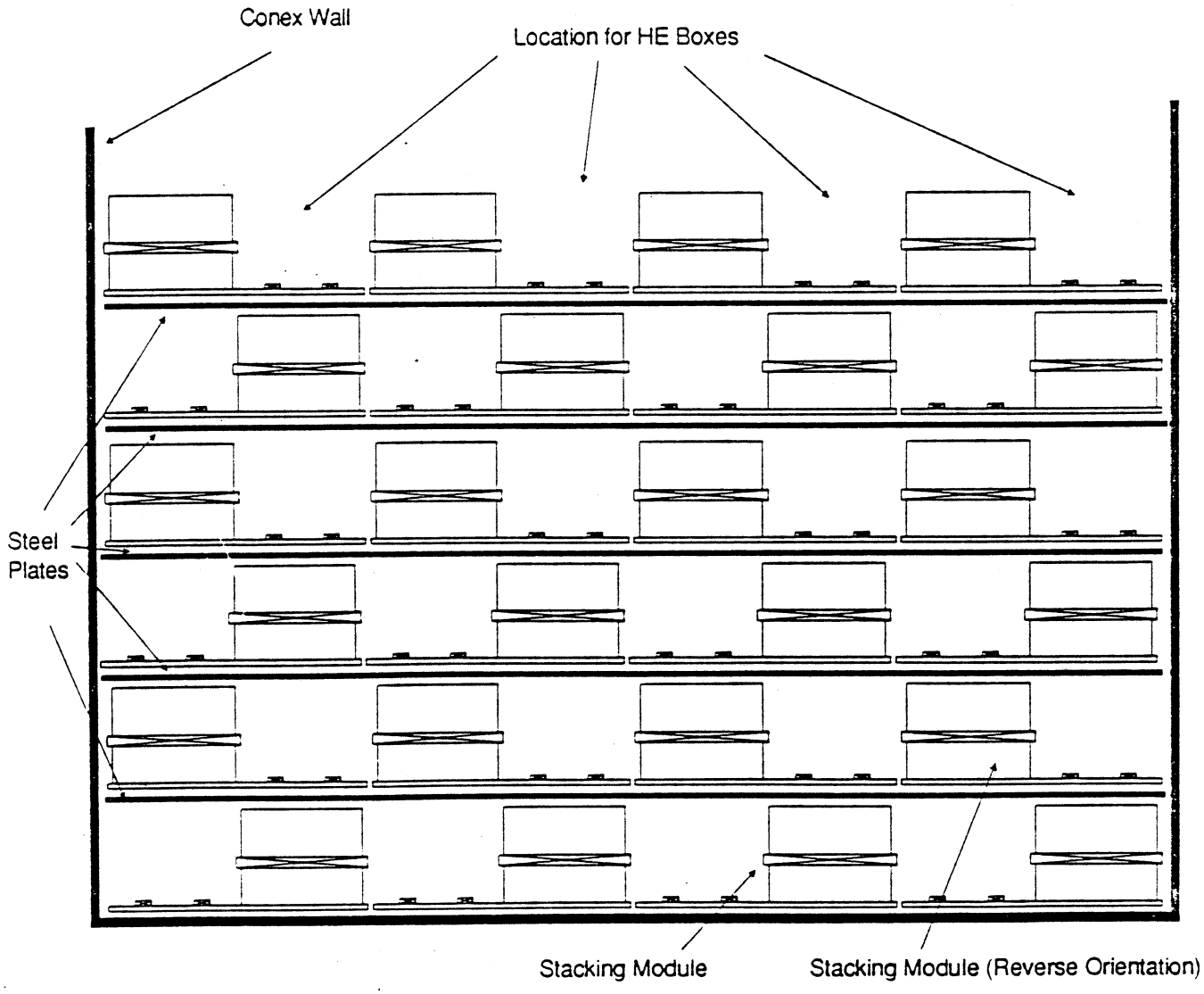

Stacking Modules with
reverse orientation
27 in wide 1/4 in
thick steel plate
Stacking Modules

Figure 5



Assembled Rack (without mortar boxes)

Overhead View



Inside View of Rack

Figure 6

Photo of Rack Without Ammunition

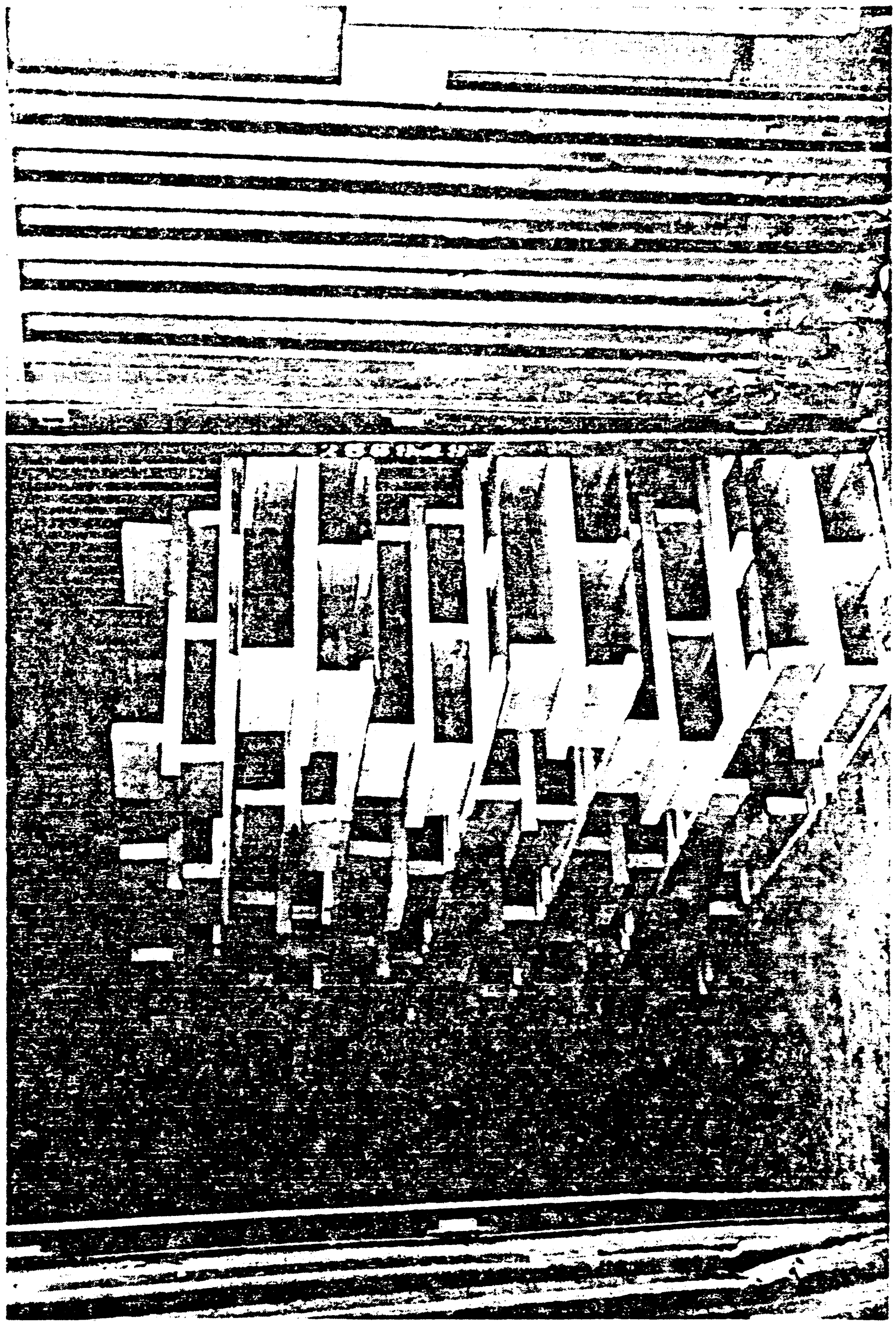


Figure 7

Photo of Rack with Ammunition

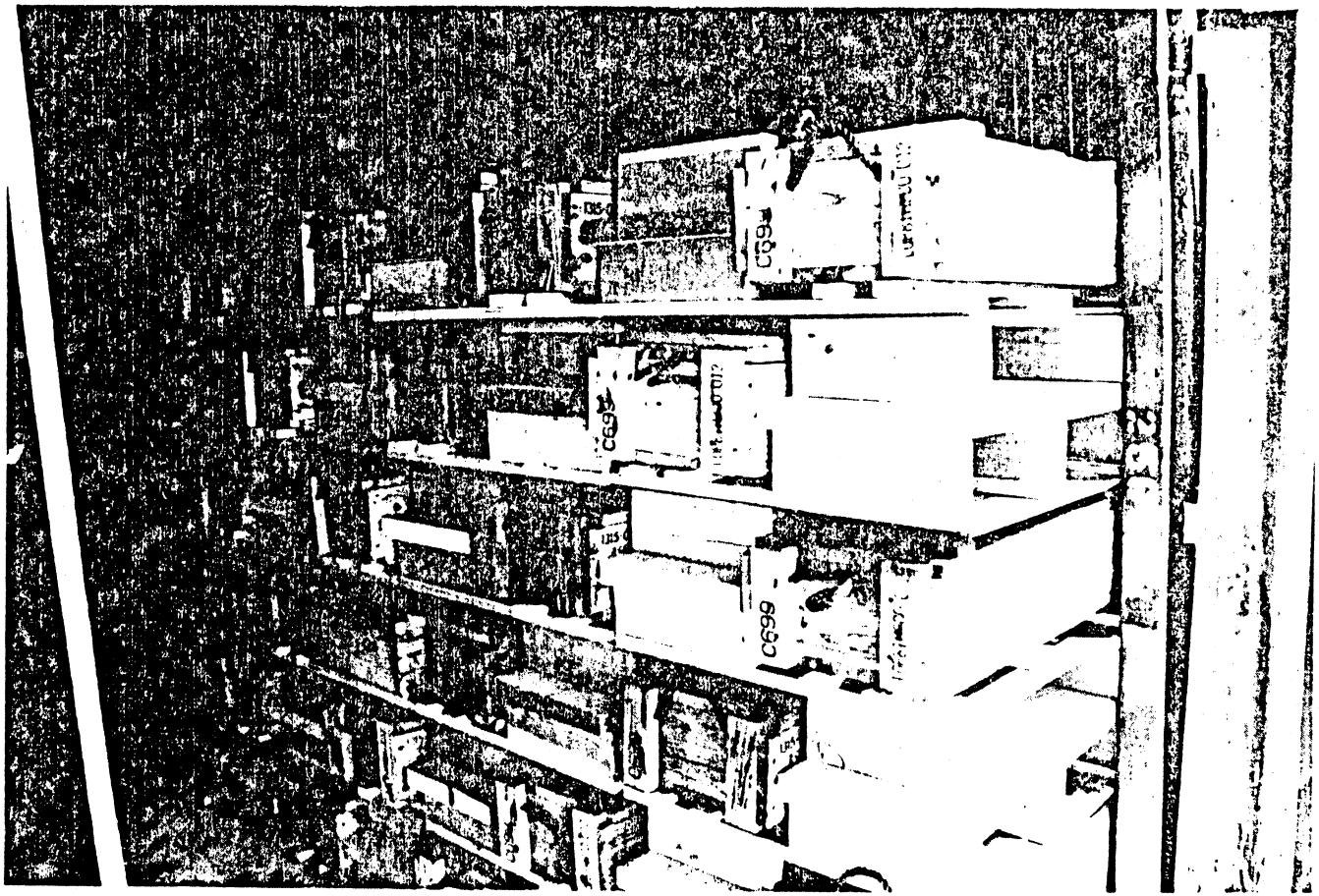


Figure 8

Front Barrier

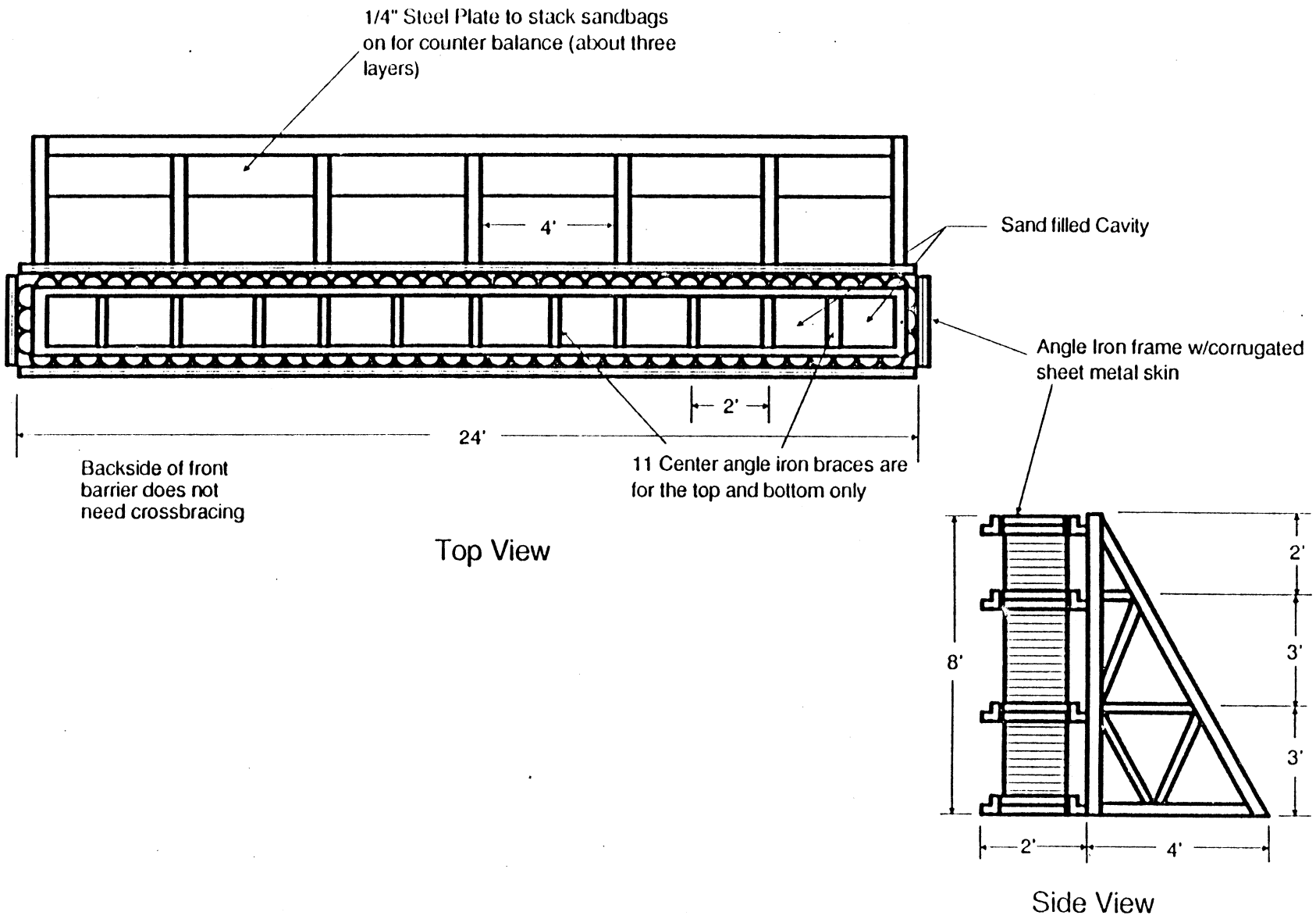
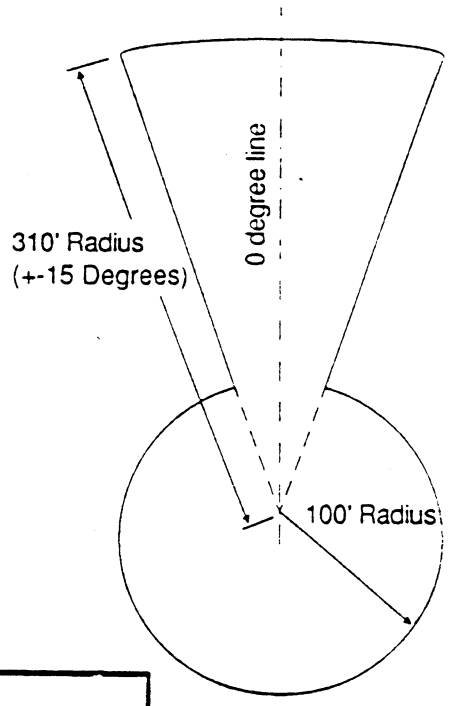
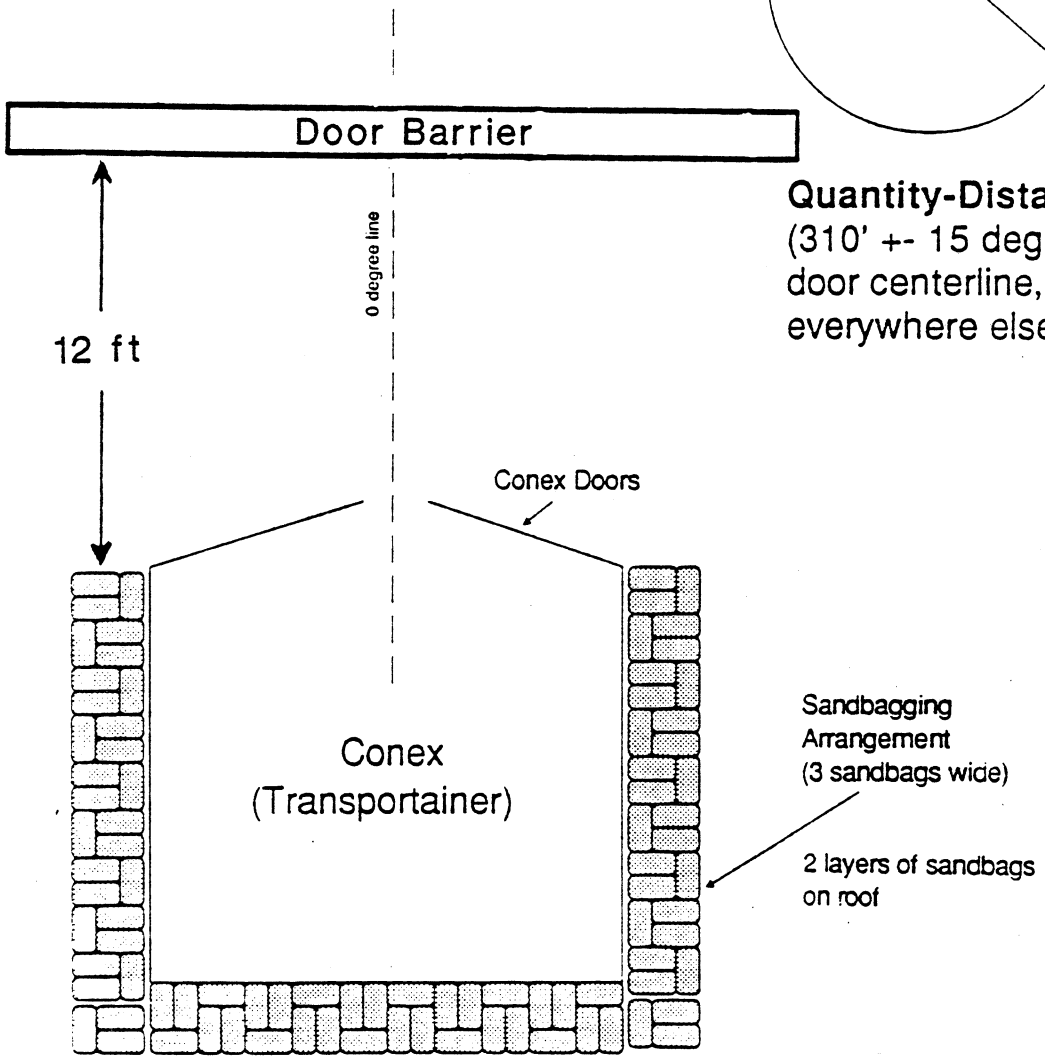


Figure 9

Quantity-Distance and Sandbagging



Quantity-Distance
(310' +- 15 degrees from door centerline, 100' everywhere else)



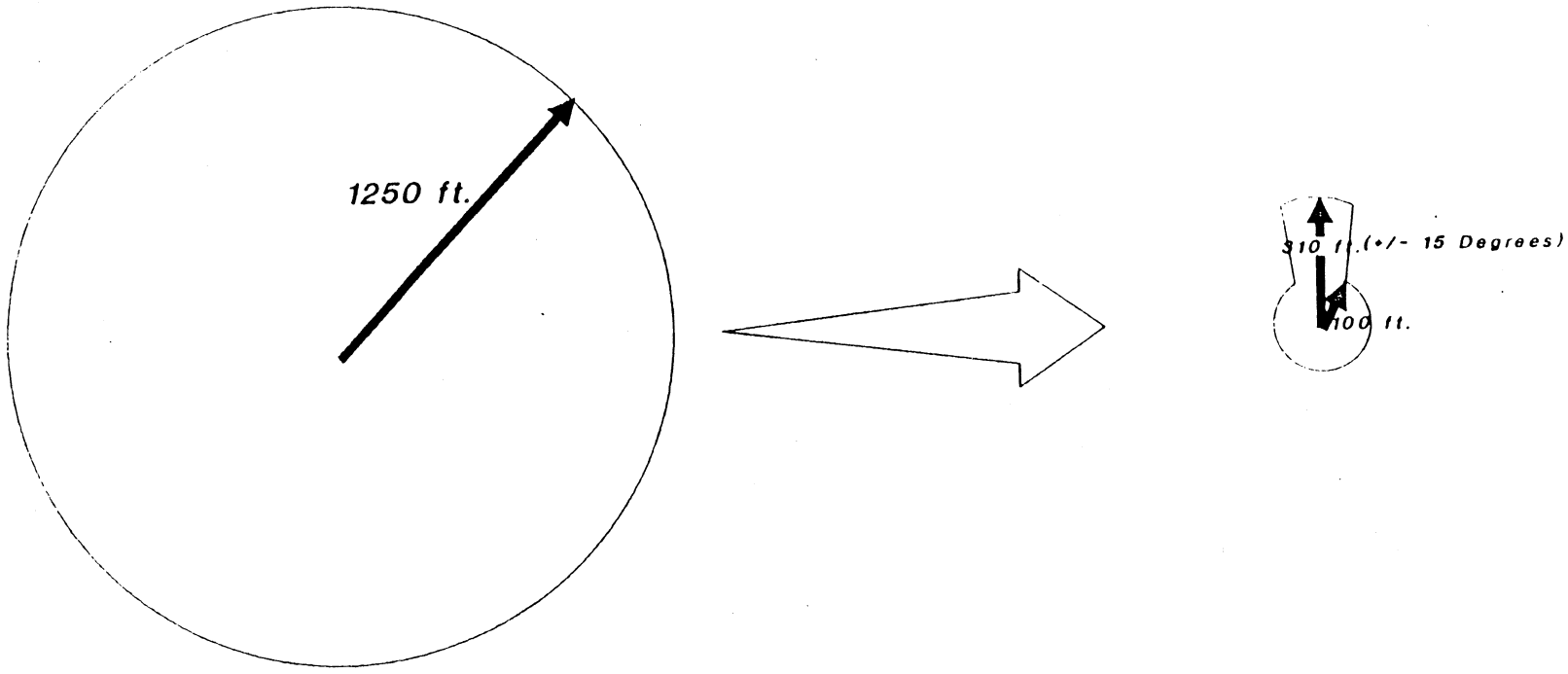
Overhead View

Figure 10

QUANTITY DISTANCE REDUCTION
STORAGE OF 48 HE FILLED 4.2" MORTARS
INHABITED BUILDING DISTANCE

CONEX WITHOUT RACK

CONEX WITH RACK



REQUIRES 113 ACRES ENCUMBERED LAND

REQUIRES 1 ACRE ENCUMBERED LAND

Storage Density Increase = 11,200%

Figure 11